Methyl bromide alternatives

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From the Deputy Secretary

As you may know, the Montreal Protocol of 1991 placed methyl bromide in a category of chemicals defined as contributory to depleting the ozone layer. In light of this, the Environmental Protection Agency initiated action under our Clean Air Act to phase out use and production of methyl bromide by January 1, 2001.

This chemical is critical to American agriculture and is used extensively as a soil fumigant and in postharvest storage as well as in quarantine treatments to control many pests on various crops.

We have made this issue a high priority because of the potential adverse impacts on American agriculture. Unless viable alternatives are found, U.S. farmers will be at a distinct disadvantage in domestic and international agriculture and trade when the ban takes effect. A major research effort is necessary to ensure that American farmers can continue to raise and market their crops.

Therefore, USDA has directed a significant portion of research resources and expertise to the identification and development of substitutes and alternatives to methyl bromide for soil fumigation, postharvest protection, and quarantine.

As we continue an aggressive program to ensure that farmers have adequate alternatives for production and trade uses, we must also ensure that farmers are not placed at a competitive disadvantage by the phaseout of methyl bromide. We support legislative solutions that meet the needs of American farmers and prevent competitive disadvantage, while recognizing that continued progress on the development of effective and economical alternatives is in the best long-term interest of agriculture.

The purpose of this newsletter is to keep you abreast of what is happening as this research progresses and to serve as a link between the researchers and the agricultural producers, marketers, and consumers. I know that the methyl bromide issue is of great importance to each of you, as it is to USDA.

Richard Rominger
Deputy Secretary

Inside This Issue

This newsletter provides information on research for methyl bromide alternatives from USDA, universities, and industry.

Address technical questions to Kenneth W. Vick, USDA, ARS, National Program Staff, Bldg. 005, Room 237, BARC-West, 10300 Baltimore Ave. Beltsville, MD 20705. Phone (301) 504-5321, Fax (301) 504-5987.

Address suggestions and requests to be added to the mailing list to Doris Stanley, USDA, ARS, Information Staff, 6303 Ivy Lane, Room 444, Greenbelt, MD 20770. Phone (301) 344-2963, Fax (301) 344-2311.

U.S. Department of Agriculture

From the Deputy Under Secretary for Research, Education, and Economics

Since coming to the Under Secretary's office several months ago, I have become acutely aware of the significant impact the loss of methyl bromide will have on U.S. agriculture if practical, effective alternatives are not found. I recently spent time in California and Florida listening to concerns from a wide range of agricultural interests regarding a methyl bromide ban. We have given and will continue to give high priority to finding alternatives to this chemical.

In June 1993, USDA brought together 250 Federal and State scientists and representatives of the agricultural community to evaluate existing and potential methyl bromide alternatives and identify research needs and priorities. The proceedings of that conference have guided subsequent USDA research decisions.

In 1993, the methyl bromide research program of the Agricultural Research Service, our in-house research agency, totaled about $7 million. This resulted from our long-standing policy to reduce agriculture's reliance on pesticides. In FY 1994, Congress increased the ARS effort to $8 million. In FY 1995, Congress instructed ARS to increase that amount to the present $13 million by redirecting $5 million from lower priority research areas. ARS has provided more than $850,000 in cooperative agreements in the past 3 years to support research programs of university scientists on methyl bromide preplant alternatives. This effort was primarily directed to California and Florida, the two States most directly affected by the proposed ban.

USDA, the Crop Protection Coalition, and the U.S. Environmental Protection Agency sponsor an annual conference on the latest research results, an outgrowth of the June 1993 meeting.

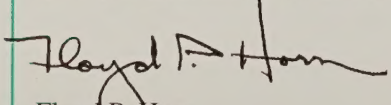
A technical committee with members from EPA and USDA meets regularly to review and resolve registration issues for methyl bromide replacement chemicals. USDA is also working with foreign government officials to try to ease methyl bromide requirements now placed on U.S. commodity exports.

Prospects for increased funding are uncertain for research on methyl bromide alternatives. The House provided ARS with an additional $2 million, but the Senate provided no increase. The funding situation will not be known until after the conference committee meets.

The impending ban of methyl bromide presents very complex problems. More than 100 crops depend on methyl bromide in some way. Differences in soil types, weather, importing country requirements, and other factors complicate the issue.

Good communications and coordination are essential to achieving maximum positive effect from our research efforts. We hope this quarterly newsletter will provide a link between the research and agricultural communities, help define agricultural problems and communicate possible solutions.

If we are to solve these problems, all players—private, State, and Federal—must pull together. USDA will continue to place high priority on working with you, our partners, to find practical and effective alternatives for methyl bromide.



Floyd P. Horn
Deputy Under Secretary

New ARS Projects

To meet the crisis that elimination of methyl bromide will impose on U.S. agriculture, the Agricultural Research Service has redirected funds from other research programs to create five new full-time positions for developing viable alternatives. One of these positions is located at Fort Pierce, Florida; three are in California, at Fresno, Davis, and Salinas; and one is at Wenatchee, Washington.

These positions have been filled by scientists who are backed by years of dedicated training and research in plant pathology and physiology—all essential in finding ways to keep our agriculture productive and competitive in world markets.

Florida

ARS plant physiologist David Patterson is addressing the problem of weeds. Patterson recently transferred from the ARS Plant Physiology Research Unit at Raleigh, North Carolina, to Fort Pierce, Florida, future site of the ARS Horticultural Research Laboratory at Orlando. He received his undergraduate degree from North Carolina State University and master's and Ph.D. degrees from Duke University.

Patterson's assignment involves the biology and control of nutsedges, weeds that are rampant wherever vegetables are grown. Methyl bromide is currently the most effective control for yellow and purple nutsedge. Purple nutsedge is known as the world's worst weed.

"Neither of these species produces much viable seed, so they must move more slowly than other weeds to infest vegetable crops," Patterson says. "We'll study the biology and epidemiology of these pernicious weeds, hoping to find ways to slow their spread in the field and reduce their emergence."

He expects to evaluate cultural practices, composting, and different types of mulches that might offer weed control.

California

ARS plant pathologist Cynthia G. Eayre has a research background in soilborne pathogens of horticultural crops. After receiving a Ph.D. from North Carolina State University, she held postdoctoral positions at the University of Florida and the ARS Crop Quality and Fruit Insects Research Unit in Weslaco, Texas.

Now assigned to the ARS Postharvest Quality and Genetics Research Unit at Fresno, California, Eayre will work on biologically based alternatives to methyl bromide as a soil fumigant for strawberries and stone fruits.

"We will try to identify the causes of strawberry root rot so we can reproduce the disease in control experiments," Eayre says. She and colleagues will test beneficial bacteria—recently found to ward off disease in cantaloupe—to try to induce plant resistance to the rot. She plans to work with the ARS Water Management Unit to try drip-trickle irrigation as a delivery system for this and other control agents.

Eayre is particularly interested in root knot nematode resistance in peaches and in working with a fungus, *Hirsutella,* that attacks the ring nematode, another pest of stone fruit. She plans trials of combinations of biological control agents and chemical treatments.

ARS recently added plant pathologist Greg Browne to the research team at the Crops Pathology and Genetics Laboratory in Davis, California. Browne received a Ph.D. in plant pathology from the University of California at Davis and later worked for UC's Cooperative Extension, specializing in diseases of vegetable crops.

At the ARS-Davis lab, Browne will investigate ways to control soilborne diseases that affect fruit and nut trees and grapes. His research will help develop methyl bromide alternatives.

"An important part of my program will be to find and evaluate genetic resistance to important soilborne pathogens in rootstocks of fruit and nut trees like peaches, almonds, and walnuts," he says. "Also, we need to learn more about the biology and control of soilborne pathogens like Phytophthora that affect plant vigor and productivity. We'll need this kind of information to effectively integrate methyl bromide alternatives."

Browne says cultural, genetic, and chemical strategies will all play important roles in finding methyl bromide replacements.

Plant pathologist Frank Martin will tackle the problem of finding alternatives to methyl bromide from an ecological perspective. Martin is now part of the research team at the ARS Crop Improvement and Protection Research Unit at Salinas, California. He received his Ph.D. degree in plant pathology from the University of California, Berkeley, and came to ARS from the University of Florida where he worked as an assistant professor on the ecology, biocontrol, and genetics of fungal soilborne

pathogens as they affect a wide range of vegetable crops.

At Salinas, Martin's research objectives include investigating the ecology and biology of soilborne pathogens and developing biocontrol strategies from an ecological perspective. In addition, he will continue research on controlling damping-off of vegetable transplants using a biocontrol agent developed while at the University of Florida. Damping-off, caused by fungi, is a serious disease of seeds and seedlings that can kill young plants as they emerge from the soil.

Washington

Plant pathologist Mark Mazzola has a background in forestry and plant pathology research and received both undergraduate and master's degrees from the University of Vermont and a Ph.D. in plant pathology from Washington State University.

From a temporary research position studying soilborne pathogens of wheat with ARS at Pullman, Washington, Mazzola was recently assigned to work full time at the Tree Fruit Research Laboratory in Wenatchee, seeking biologically based alternatives for methyl bromide as a soil fumigant.

"My concern is with an old phenomenon—apple replant disease—that to date hasn't been very well characterized," he says. "In the absence of methyl bromide, growers and nurserymen can lose up to 20-30 percent of new orchard plantings to this disease."

Methyl bromide is now used to fumigate soil to eliminate potential soilborne pathogens in orchards that are being renovated by removing old trees and planting new apple varieties. It's difficult to treat this disease with other materials, Mazzola says, because the exact cause is not known and may vary between geographic regions.

While seeking a causal agent, Mazzola plans to investigate the potential role of fungal pathogens in apple replant disease and evaluate biological agents to control it. He is looking at the biological control capabilities of *Trichoderma,* a common soilborne fungus that has been used experimentally to control other plant diseases.

Focus on Florida

From Florida—Origin of Winter's Food Supply

More than half of the fresh fruits and vegetables eaten by Americans during winter months are grown in Florida. To produce this bounty, Florida growers plant more than 850,000 acres of citrus and over 10 million acres of other crops and pasture.

"With the loss of methyl bromide, Florida fruit and vegetable growers stand to lose more than $600 million annually for the winter growing season alone," reports John Van Sickle, an agricultural economist with the University of Florida's Food and Resource Economics Department at Gainesville. "For fresh citrus, the loss would be over $13 million."

Including lost sales from inputs and services that would have been required to grow and market these crops, the total sales loss in Florida would exceed $1 billion and cost the economy more than 13,000 jobs. Van Sickle says this estimate is based on using methyl bromide alternatives that are currently available.

A report by Van Sickle was recently released as "Long Term Economic Assessment of the Loss of Methyl Bromide on Florida," based on a study financed by USDA's National Agricultural Pesticide Impact Assessment Program.

The report covers methyl bromide as a soil fumigant for tomatoes, strawberries, cucumbers, watermelon, bell peppers, eggplant, and squash and as a postharvest treatment for fresh citrus. It did not consider or place a monetary value on the loss of methyl bromide as an emergency postharvest treatment to move commodities from a quarantined area in the event of an invasion of fruit flies or other serious pests. Currently, methyl bromide is the only effective treatment for such an invasion.

"We looked at both chemical and nonchemical alternatives to methyl bromide," says Van Sickle. "Our focus was primarily on technology and products that would be a suitable substitute with the least economic impact on growers."

In conducting the study, Van Sickle worked with growers, horticulturists, entomologists, and nematologists to determine the impact that loss of methyl bromide would have on Florida's crop production.

"Even though we focused on estimating the impact on Florida, our model does include production and measures of impact on other national and international growers who sell product in the United States during the winter market," he says.

From Florida—Continued

His report predicts that tomato production in Florida will decrease more than 60 percent and planted acreage will drop by more than 43 percent if methyl bromide is banned before more suitable alternatives are found.

It is not known if methyl bromide will be banned by the Montreal Protocol. But if it is banned, developing countries may be allowed to use methyl bromide to produce and market crops for 10 years after the United States' 2001 cutoff date.

Van Sickle estimates that with the loss of methyl bromide in the United States, Mexican production of tomatoes will increase 80 percent; bell peppers, 54 percent; cucumbers, 7 percent; and eggplant, 143 percent.

"We'll lose our competitive edge to Mexico, a developing country, unless we come up with better substitutes for methyl bromide," he says.

Co-op Research

Technical Research Reports

Not only is USDA doing inhouse research on the methyl bromide issue, but through the Agricultural Research Service, more than $850,000 has been provided over the past 3 years to support work by university scientists on this issue.

Following are technical research reports from the University of Florida's Cooperative Extension Service and the University of California at Davis.

Progress Report on USDA-ARS Specific Cooperative Agreement, "Integrated Management of Soilborne Pests of Tomato as an Alternative to Methyl Bromide"

Principal Investigator: D.O. Chellemi, University of Florida, North Florida Research and Education Center, Quincy, Florida

Cooperators: S.M. Olson, R. McSorley, D.J. Mitchell, W.M. Stall, R.J. McGovern, D.W. Dickson, T.R. Sinclair, F.M. Rhoads, J.E. Funderburk, and J.R. Rich.

Using fall production of fresh market tomato in Florida as the model cropping system, studies conducted in 1994 indicated that yields identical to those obtained with methyl bromide:chloropicrin can be achieved using soil solarization.

Soil solarization effectively controlled populations of weeds (including nutsedge), plant parasitic nematodes and *Fusarium* wilt. In addition, soil solarization is fully compatible with standard production practices and results in savings of over $250 per acre when compared to the cost of fumigating with methyl bromide:chloropicrin.

Field experiments are being conducted in 1995 to further evaluate the effects of various combinations of chemical fumigants, organic amendments, soil solarization and gas impermeable plastic films in combination with reduced rates of chemical fumigants on the incidence of soilborne pests, populations of beneficial microorganisms and yield of fresh market tomato. Studies are also being conducted to further optimize the performance of soil solarization and alternative chemical fumigants.

Fumigation with Telone C-17 and soil solarization, with and without reduced rates of methyl bromide:chloropicrin or Telone C-17, are currently being evaluated in large 2- to 5-acre plots in three commercial tomato production plantings.

A soil solarization field day was conducted on August 28 at th North Florida Research and Education Center. The field day was attended by commercial growers, county extension faculty and Professor Jaacov Katan from the Hebrew University of Jerusalem and provided an excellent forum for positive exchange of ideas on implementing methyl bromide alternatives.

Progress Report on USDA-ARS Cooperative Agreement, "Development of Alternative Technology to Methyl Bromide Fumigation for Control of Soilborne Diseases of Strawberries"

Principal Investigator: J.M. Duniway, Department of Plant Pathology, University of California, Davis, CA 95616

Cooperators: W.D. Gubler, Department of Plant Pathology, University of California, Davis, CA 95616; L.H. Aung, USDA, ARS, Horticultural Crops Research Laboratory, Fresno, CA 93727.

The experiments reported here are part of a larger project supported by the California Strawberry Commission and USDA-ARS to research chemical and non-chemical alternatives to methyl bromide for preplant fumigation of soil in strawberry production.

Co-op Research—Continued

Chemical alternatives to methyl bromide were tested in two large field experiments near Watsonville, CA. Both fields had been fumigated previously prior to planting strawberries in a strawberry-vegetable rotation. In September of 1993 and 1994, one of the fields was cultivated flat, divided into three replicate blocks, and further divided for preplant treatments of soil, i.e., fumigation with methyl bromide/chloropicrin (67/33 percent at 325 pounds per acre), chloropicrin (300 pounds per acre, Telone II (1,3-dichloropropene)/chloropicrin (70/30 percent at 454 pounds per acre, or 30/70 percent at 409 pounds per acre) or not treated.

Fumigants were injected at 20 cm depth (broadcast treatment) and the soil was immediately covered with a polyethylene tarpaulin. Non-treated soil was not covered. The tarpaulin was removed after five days, beds were raised, and the strawberry cultivar Selva was transplanted (2 rows/bed) approximately 6 weeks after soil treatment. Conventional practices for strawberry production and pest management were followed, including sprinkler irrigation initially and drip irrigation at bed centers in the production season.

All chemicals used reduced total populations of fungi in soil by 65 to 85 percent relative to populations in non-treated soil, while total populations of bacteria were variable and were not generally reduced significantly by the chemical treatments used. Plant parasitic nematodes and *Verticillium* populations were measured separately and were low in all soil treatments.

All of the fumigants listed above increased growth significantly relative to that in non-fumigated soil. The incidence of transplant failures and plants with recognizable diseases (e.g., Phytophthora root and crown rots, *Verticillium* wilt, or collapse of unknown etiology) were equally low in all soil treatments. Therefore, average growth and yield differences were due largely to overall differences in plant growth and vigor.

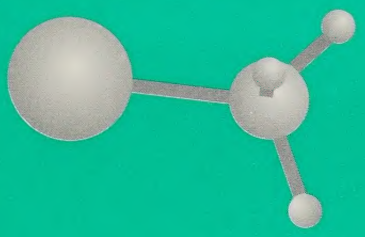
Berries were picked for fresh market at least twice weekly by normal grower practice starting April 1 and continuing into November. Berry yields for the methyl bromide/chloropicrin, chloropicrin, and Telone II/chloropicrin treatments were nearly the same, while yields in non-treated soil were significantly (40-49 percent) less than in other treatments.

Although more long-term research is needed, the results from these two experiments suggest that (a) methyl bromide/chloropicrin, chloropicrin alone, and Telone II/chloropicrin worked equally well on ground with a history of vegetable-strawberry rotation and previous fumigation, and (b) that growth and yield responses to fumigation in strawberry occurred in the absence of significant pressure from known diseases. Even larger responses to fumigation are expected where known soilborne pathogens are present at potentially damaging levels.

Bed fumigation treatments are being compared in a separate experiment at a field site near Watsonville, CA, where *Verticillium* populations are high. While none of the bed fumigation treatments gave the level of disease control or yield expected following broadcast fumigation with methyl bromide/chloropicrin, all the chemicals listed above, as well as Basamid (Dazomet, 400 pounds per acre) and methyl iodide (365 pounds per acre) increased yields significantly and reduced the incidence of plants with *Verticillium* wilt by approximately 50 percent relative to a non-treated control. *Verticillium* populations in soil increased during the growth of strawberries.

In a rotation experiment at Davis, CA, strawberries planted in non-fumigated soil following broccoli, strawberry or a fallow treatment had equivalent growth and yields. Broadcast fumigation with methyl bromide/chloropicrin (67/33 percent at 325 pounds per acre) before planting strawberries approximately doubled yields.

The bed fumigation and rotation experiments are being repeated with modifications in 1995-96. In addition, broadcast fumigation treatments will be reapplied in September 1995 to the ground treated in September 1993 to measure longer-term and carry-over effects of the various fumigants used. Mechanisms underlying the response of strawberries to soil fumigation and the epidemiology of *Verticillium* wilt in strawberry are also being researched.



Upcoming Meetings on Methyl Bromide

Washington, D.C.—October 23–25, 1995

Methyl bromide will be a discussion topic at the 1995 International CFC and Halon Alternatives Conference and Exhibition, being held at the Washington Hilton and Towers, Washington, D.C., on October 23–25. This conference is sponsored by The Alliance for Responsible Atmospheric Policy in cooperation with USDA, EPA, Environment Canada, and the United Nations Environment Programme.

Stratospheric ozone protection for the 90's is the theme, with focus on technology and policy concerning ozone-depleting compounds and their alternatives. A session on methyl bromide is scheduled for each day; these will include:

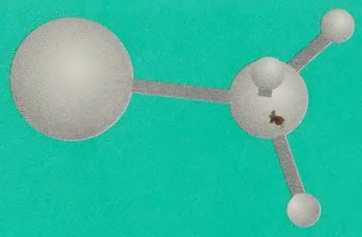
- Policy issues related to methyl bromide
- Update on research for alternatives to methyl bromide
- Irradiation as a postharvest treatment
- Soil fumigation—commercially available alternatives
- Alternatives and emission controls
- Commodity issues

Fax registration to (301) 695-0175, or write to International CFC and Halon Alternatives Conference, P.O. Box 236, Frederick, MD 21701. Participants may register onsite.

San Diego, California—November 6–8, 1995

The second Annual International Research Conference on Methyl Bromide Alternatives and Emissions Reduction is being held November 6–8, 1995, in San Diego, California. Sponsored by the U.S. Department of Agriculture, the Crop Protection Coalition, and the U.S. Environmental Protection Agency, the conference is being held to:

- Enhance scientific information and data exchange on methyl bromide alternatives research
- Provide a forum for exchange of interdisciplinary scientific and agricultural information
- Develop and distribute conference proceedings as a state-of-the-art methyl bromide alternatives source for researchers, users of methyl bromide, legislators, government policy officials, and the general public
- Support data gathering on potential alternatives to methyl bromide for future evaluation and prioritization



Upcoming Meetings—Continued

- Monitor development of viable alternatives to methyl bromide
- Evaluate technology transfer processes and incentive programs needed to implement alternatives

Scientists from more than 28 countries are expected to attend the conference, with officials from several Nations discussing negotiations of quarantine procedures relative to the loss of methyl bromide. USDA officials will review the international quarantine situation, and EPA will update regulatory issues.

In addition to discussions on alternatives for preplant, postharvest, and structural uses, two new sessions on forestry and radiation are on the agenda this year. Roundtable discussions will be held on finding and implementing alternatives.

For registration or more information call the Methyl Bromide Alternatives Outreach at (209) 244–4710, fax (209) 224–2610.